FEMI.209:360805
ORI
COMPLETED
17

FLOOD INSURANCE STUDY

WAVE HEIGHT ANALYSIS

TOWN OF RIVERHEAD, NEW YORK
SUFFOLK COUNTY

JUNE 1, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 360805

ANALYSIS OF WAVE HEIGHTS

FOR

TOWN OF RIVERHEAD, SUFFOLK COUNTY, NEW YORK

For

FEDERAL EMERGENCY MANAGEMENT AGENCY

BEST DOCUMENT AVAILABLE

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Background and Purpose	1
2.0	INVESTIGATIONS	2
	2.1 Previous Studies	2
	2.2 Data Collection and Review	2
	2.3 Wave Height Analysis	3
	2.4 Results	5
3.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	7
	3.1 Flood Boundaries	7
	3.2 Base Flood Elevations	7
	3.3 Velocity Zones	8
4.0	INSURANCE APPLICATION	8
	4.1 Flood Hazard Factors	8
	4.2 Flood Insurance Zones	9
	4.3 Flood Insurance Rate Map	9
5.0	OTHER STUDIES	10
6.0	REFERENCES	10

BEST DOCUMENT AVAILABLE

TABLE OF CONTENTS - continued

Page

FIGURES

Figure 1 - Transect Location Map 4

Figure 2 - Typical Transect Schematic 6

TABLES

Table 1 - Transect Descriptions 5

Table 2 - Flood Insurance Zone Data 10

BEST DOCUMENT AVAILABLE

1.0 INTRODUCTION

1.1 Background and Purpose

The Federal Emergency Management Agency (FEMA) recently adopted recommendations by the National Academy of Sciences to include prediction of wave heights in Flood Insurance Studies for coastal communities subject to storm surge flooding, and to report the estimated wave crest elevations as the base flood elevations on Flood Insurance Rate Maps (FIRMs).

Previously, FIRMs were produced showing only the stillwater-storm surge elevations due to the lack of a suitable and generally applicable methodology for estimating the wave crest elevations associated with storm surges. These stillwater elevations were subsequently stipulated in community flood plain management ordinances as the minimum elevation of the first floor including basement of new construction. Communities and individuals had to consider the additional hazards of velocity waters and wave action on an ad hoc basis. Because there has been a pronounced tendency for buildings to be constructed only to meet minimum standards, without consideration of the additional hazard due to wave height, increasing numbers of people could unknowingly be accepting a high degree of flood-related personal and property risk in coastal areas subject to wave action. Therefore, the FEMA has pursued the development of a suitable methodology for estimating the wave crest elevations associated with storm surges. The recent development of such a methodology by the National Academy of Sciences has led to the adoption of wave crest elevations for use as the base flood elevations in coastal communities (Reference 1).

The hurricane of 1815 was one of the most severe hurricanes to effect eastern Long Island. The hurricane of 1938 caused loss of life and extensive property damage and was probably the most destructive hurricane in the history of the Town of Riverhead. Another major hurricane occurred in 1944, bringing tidal flooding and excessive rainfall, particularly along the north shore coastline of Riverhead. Other severe hurricanes affecting Riverhead occurred in 1954, 1960 and 1976. The 1976 hurricane did not produce extensive flooding hazards for Riverhead.

Northeasters have caused flooding problems in the Town of Riverhead, particularly along Peconic Bay and the Peconic River estuary. The northeaster of November 17, 1935 caused high tides within the town. Severe northeasters also occurred in 1936, 1950, 1953, 1958, 1968, 1973 and 1974.

The purpose of this study is to revise the FIRM for the Town of Riverhead to include the effects of wave action for the following flooding source: Long Island Sound.

BEST DOCUMENT AVAILABLE

2.0 INVESTIGATIONS

2.1 Previous Studies

The stillwater elevations used for this analysis were taken from the previous Flood Insurance Study for the Town of Riverhead, Suffolk County, New York (Reference 2).

2.2 Data Collection and Review

All available source data applicable for the wave height analysis were collected and reviewed. Because wave height calculations are based on such parameters as the size and density of vegetation, natural barriers (sand dunes), buildings, and other manmade structures, it was necessary to obtain detailed information on the physical and cultural features of the study area.

The Suffolk County Planning Commission, the Aero Graphics Corporation of Bohemia, New York and the Town of Riverhead were contacted for data pertinent to the study.

The principal source materials used for the wave height analysis are described below.

1. Aerial photographs at a scale of 1:12,000 (stereoscopic coverage) of the Town of Riverhead were obtained from Aero Graphics Corporation of Bohemia, New York (Reference 3). The photographs were used to determine physical features and the type, size, and density of vegetation.

2. Detailed topographic maps for Riverhead, New York, at a scale of 1:2,400 and a contour interval of 5 feet, with several spot elevations, were obtained from the Suffolk County Department of Public Works (Reference 4). These were used as the work maps for the wave height calculations and for plotting wave elevations and boundaries of the Flood Hazard Zones (Section 3.1).

3. Stillwater elevations for the storm surges used in this analysis were taken from the previous Flood Insurance Study for the Town of Riverhead (Reference 2).

4. U. S. Geological Survey (USGS) topographic maps of Wading River, Riverhead and Mattituck, New York, were used for the placement of transects and for fetch calculations (Reference 5).

BEST DOCUMENT AVAILABLE

2.3 Wave Height Analysis

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences report (Reference 1). This method is based on three major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures described in Reference 1. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth. The methodology is based on the assumption that there is a high correlation between the n-year storm surge and the n-year wave heights. This assumption will be met when the wind field that is present during the peak of the surge is used in the computation of the wave heights.

Wave heights were computed along transects (cross section lines) that were located along the coastal areas, as illustrated in Figure 1, in accordance with the Users Manual for Wave Height Analysis (Reference 6). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, physical features and wind direction. The wind field considered for this analysis was limited to the northwest through north to the northeast. The stillwater elevations for the 100-year flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the V Zone (area with velocity wave action) was also computed at each transect. Table 1 provides a listing of the transect location and stillwater starting elevations, as well as maximum wave crest elevations. All dunes and structures were assumed to remain intact for the purposes of this analysis.

BEST DOCUMENT AVAILABLE

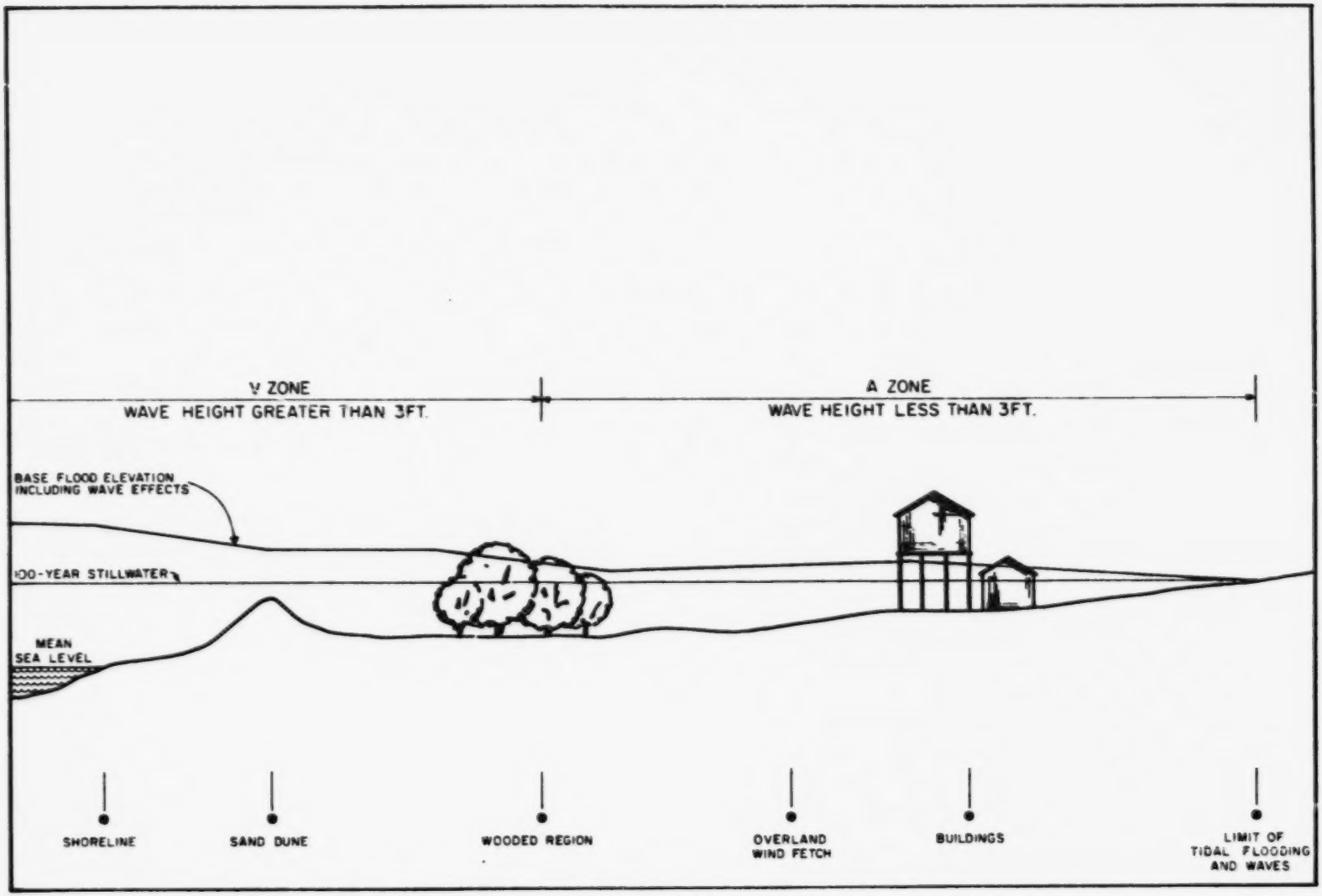


FIGURE 2
TYPICAL TRANSECT SCHEMATIC

BEST DOCUMENT AVAILABLE

TABLE 1 - TRANSECT DESCRIPTIONS

Transect	Location	Elevation (feet) Stillwater 100-year	Elevation (feet) Maximum Wave Crest 100-year
No. 1	Western corporate limits to Edwards Avenue extended	10.8	17
No. 2	Edwards Avenue, extended, to Pennys Road extended	10.8	17
No. 3	Pennys Road, extended, to the eastern corporate limits	10.8	17

Figure 2 is a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland. This figure shows the wave elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Actual wave conditions in the Town of Riverhead may not include all the situations illustrated in Figure 2.

After analyzing wave heights along each transect, wave elevations were interpolated between transects. Various source data were used in the interpolation, including the topographic work maps, aerial photographs and engineering judgement. Controlling features affecting the elevations were identified and considered in relation to their positions at a particular transect and their variation between transects.

2.4 Results

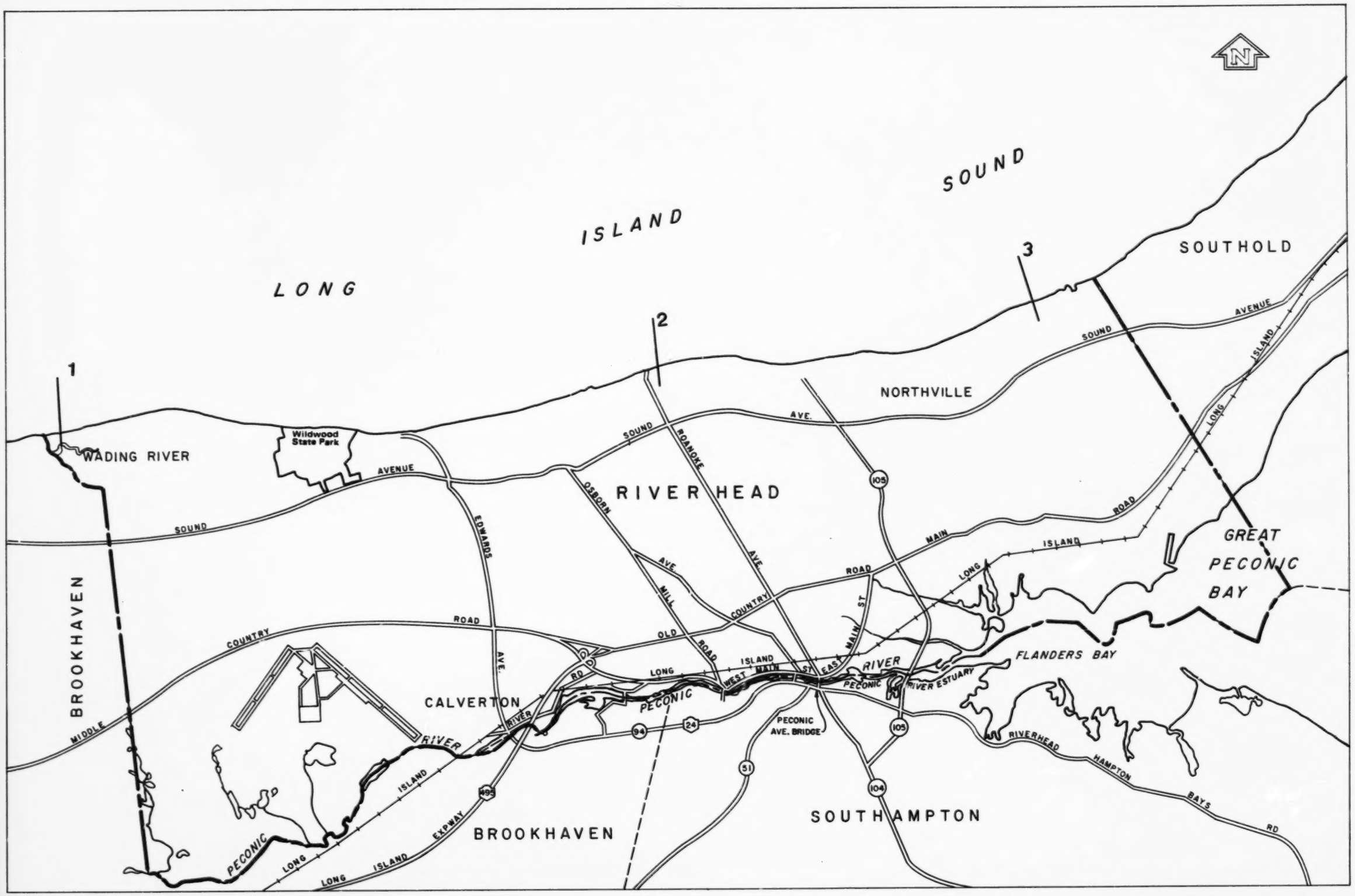
Computed wave heights and elevations associated with the 100-year storm surge are summarized below for various reaches in the study area.

Great Peconic Bay and the Peconic River did not have wave heights computed because the wind field that can be used to compute wave heights is limited. These areas may be subject to substantial wave action, but due to the limitations of the methodology, the wave heights cannot be accurately predicted.

Long Island Sound (Transects 1 - 3)

The maximum wave crest elevation from Long Island Sound is 17 feet. Wave action along the Long Island Sound shoreline does not extend beyond the shoreline area due to the bluffs with the exception of the low-lying area

BEST DOCUMENT AVAILABLE



APPROXIMATE SCALE
0 600 1200 1800 FEET

TRANSECT LOCATION MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF RIVERHEAD, NY
(SUFFOLK CO.)

FIGURE 1

BEST DOCUMENT AVAILABLE

around the Wading River. In the Wading River area, waves greater than 3 feet propagate inland approximately 200 feet to where the ground is high enough to prevent 3-foot waves. Waves less than 3 feet propagate over the marsh areas as far inland as Sound Road where rising ground elevations prohibit inundation.

The results of this study were reviewed at the final Consultation and Coordination Officer's (CCO) meeting on November 18, 1981, by representatives of the FEMA, the Town of Riverhead, and Dewberry and Davis.

3.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage local governments to adopt sound flood plain management programs designed to reduce future flood losses. The FIRM for the Town of Riverhead has been revised to incorporate the latest available information, including wave height data, to assist these communities in developing the most appropriate and effective flood plain management measures.

3.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FEMA as the base flood for purposes of flood plain management. This flood has a 1 percent chance of being equalled or exceeded each year and is expected to be exceeded once on the average during any 100-year period. The risk of having a flood of this magnitude or greater increases when periods longer than 1 year are considered. For example, over a 30-year period, there is a 26 percent chance of experiencing a flood equal to or greater than the 100-year flood. The 500-year flood plain is also shown on the FIRM to indicate areas of moderate flood hazards.

Areas inundated by the 100-year flood are shown as A and V Zones on the community's FIRM. It is in these areas that the FEMA requires local communities to exercise flood plain management measures as a condition for participation in the National Flood Insurance Program.

3.2 Base Flood Elevations

Areas within the communities studied by detailed engineering methods have base flood elevations established in A and V Zones. These are the elevations of the base (100-year) flood relative to the National Geodetic Vertical Datum (mean sea level) of 1929. In coastal areas affected by

BEST DOCUMENT AVAILABLE

wave action, base flood elevations are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in base flood elevations have been shown in 1-foot increments on the FIRMs. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. Base flood elevations shown in the wave action areas represent the average elevation within the zone. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is above the base flood elevation in A and V Zones.

3.3 Velocity Zones

The U. S. Army Corps of Engineers has established the 3-foot breaking wave as the criterion for identifying coastal high hazard zones (Reference 7). This was based on a study of wave action effects on structures. This criterion has been adopted by the FEMA for the determination of V Zones. Because of the additional hazards associated with high-energy waves, the National Flood Insurance Program regulations require much more stringent flood plain management measures in these areas, such as elevating structures on piles or piers. In addition, insurance rates in V Zones are higher than those in A Zones with similar numerical designations.

The location of the V Zone is determined by the 3-foot breaking wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the V Zone to be established. The V Zone generally extends inland to the point where the 100-year flood depth is insufficient to support a 3-foot breaking wave.

4.0 INSURANCE APPLICATIONS

The assignment of proper actuarial insurance rates requires that frequency and depth of flooding be estimated as accurately as possible. Because waves can add considerably to expected flood depths, it is important that insurance rates consider this additional hazard. The FEMA has developed a process to transform the data from this study into flood insurance criteria. This process includes the determination of Flood Hazard Factors and the designation of flood insurance zones.

4.1 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables.

BEST DOCUMENT AVAILABLE

The FHF is shown as a three-digit code that expresses the difference between the 10- and 100-year flood elevations to the nearest 0.5 foot. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, the FHF is computed to the nearest foot.

4.2 Flood Insurance Zones

After wave elevations for the 100-year storm surge were determined and mapped, the study areas were divided into zones, each having a specific flood potential and FHF. Each zone was assigned one of the following flood insurance zone designations:

Zone V9: Special Flood Hazard Areas along coasts inundated by the 100-year flood as determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to FHFs.

Zones A5 and A8: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 2, "Flood Insurance Zone Data", summarizes the FHFs, flood insurance zones, and base flood elevations for each flooding source in the study area.

4.3 Flood Insurance Rate Map

After flood insurance zones were established for the study area, the FIRM for the Town of Riverhead was revised to incorporate the new zone information. This map contains the official delineation of flood insurance zones and base flood elevations.

BEST DOCUMENT AVAILABLE

TABLE 2 - FLOOD INSURANCE ZONE DATA

Flooding Source	Stillwater Elevation 10-Year	50-Year	100-Year	500-Year	FHF	Zone	Base Flood Elevation (Feet NGVD)*
Long Island Sound Transects 1-3	7.8	9.7	10.8	14.0	045	V9	13-17
					040	A8	11-13
Great Peconic Bay	5.8	7.4	8.4	12.6	025	A5	8
Peconic River	6.8	8.5	9.2	12.6	025	A5	9

*Due to map scale limitations, base flood elevations shown on the FIRM may represent average elevations for the zones depicted.

5.0 OTHER STUDIES

Flood Insurance Rate Maps for the adjacent Towns of Brookhaven, Southampton and Southold, Suffolk County, New York are being revised concurrently with the Town of Riverhead to include wave height analyses (References 8, 9 and 10). The revised studies for Brookhaven, Southampton and Southold will be in exact agreement with this study.

6.0 REFERENCES

1. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated With Storm Surges, Washington, D. C., 1977.

2. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Town of Riverhead, Suffolk County, New York, Washington, D. C., September 1977.

3. Aero Graphics Corporation of Bohemia, New York, Aerial Photographs of the Town of Riverhead, New York, Scale 1:12,000, March 1980.

4. Suffolk County Department of Public Works, Topographic Map, Five Eastern Towns, Suffolk County, New York, Scale 1:2,400, Contour Interval 5 Feet, March 1974.

5. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Wading River, New York, 1967; Riverhead, New York, 1956; Mattituck, New York, 1956.

BEST DOCUMENT AVAILABLE